Thermal runaway, the Past, the Present and the Future?

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Thermal runaway

- If these two words do not scare the hell out of you, you are either.
- New to the battery user industry and ignorant of it's results.
- An old hand that thinks it really does come about without any warning.
- Someone that realizes there are always warning signs before it occurs.

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What is thermal runaway?

- A condition that is caused by a battery charging current or other process which produces more internal heat than the battery can dissipate.
- Pretty simple explanation for a complex process, which we will show can be detected, prevented, and recovered from.

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The monster appears unexpectedly

- The “normal” report on a thermal runaway event is described as “it occurred without warning”
- Bull crap! There always is and always has been an extended warning of a thermal runaway event.
- We just did not observe or understand the warning signals.
- It was much easier to be ignorant.

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What are these warnings?

- Increase in charge current. Starts very subtly and increases in volume over time.
- Increase in temperature differential between cell temperatures and the normal ambient temperature, which increase over time.

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The causes

- Negative plate discharge and sulfation
- Increases in the float current required
- Negative changes in internal resistances of the cells
- Dry out of the cells
- These are based upon the assumption that the float voltage is correct for the normal ambient temperature

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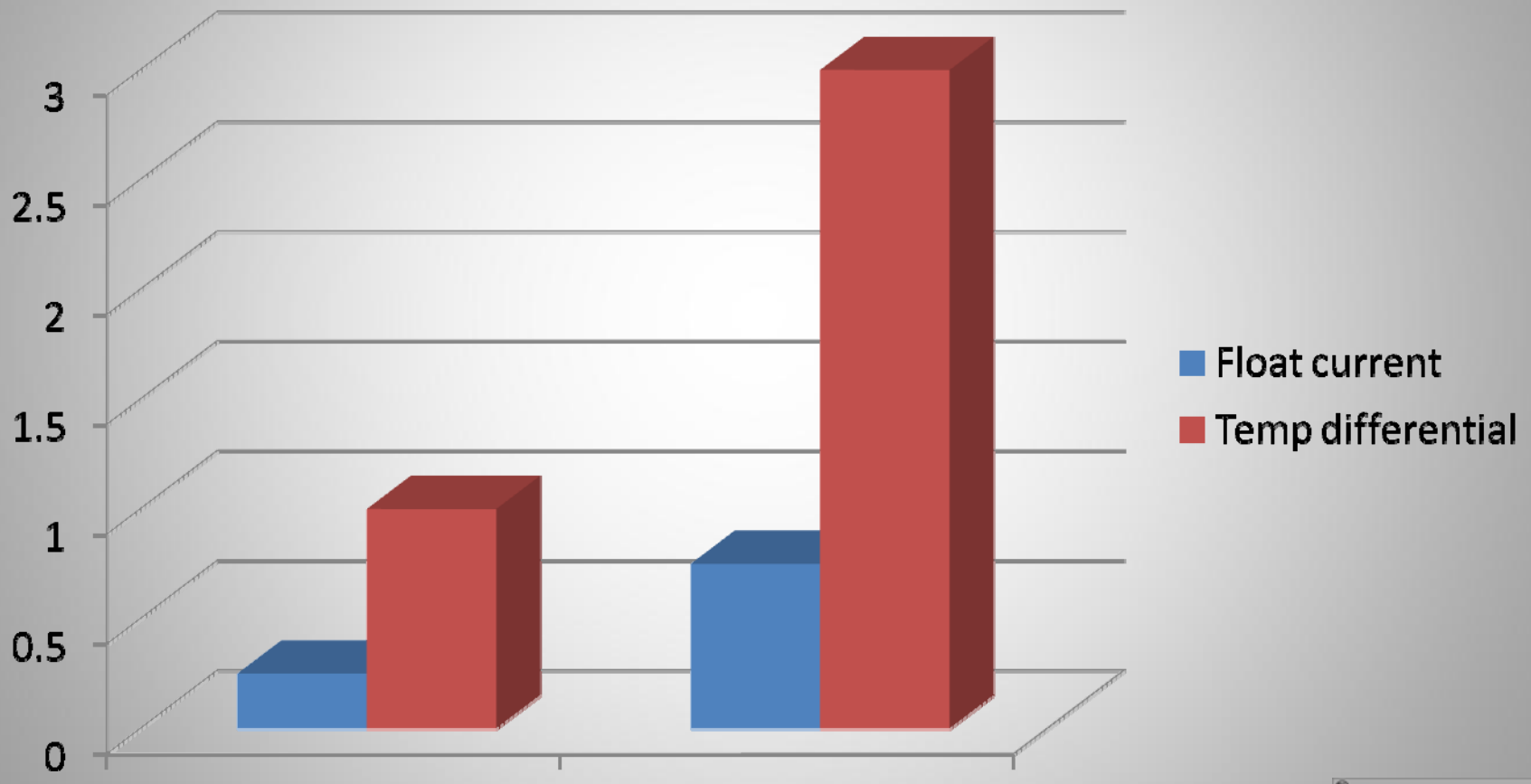
What is “normal” for 2 volt cells



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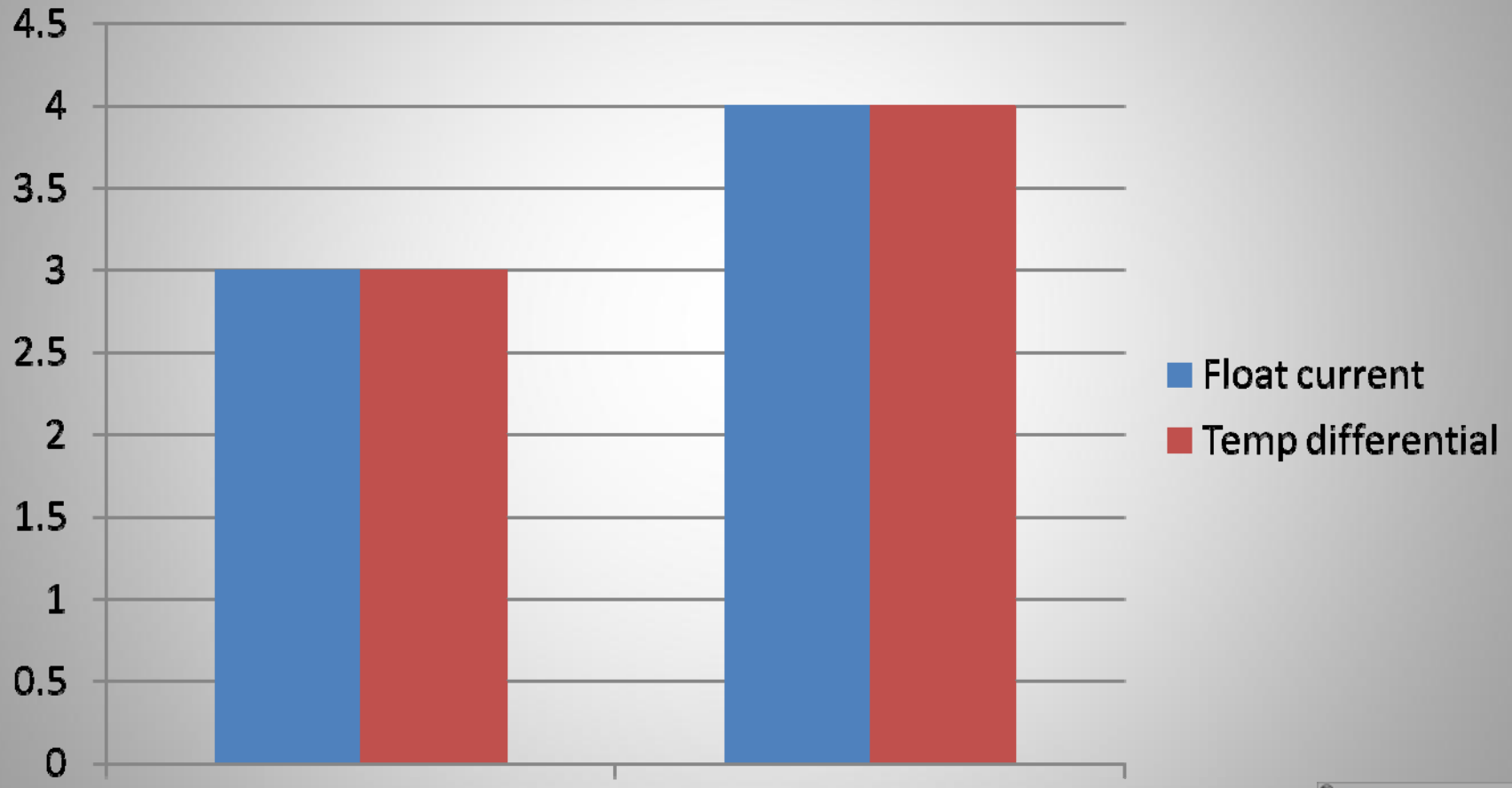
What is NOT acceptable



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How to avert thermal runaway

- Follow IEEE recommendations
- Pay special attention to float current
- Pay special attention to ambient vs. cell temps

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Corrective actions

- Re-establish proper saturation
- Remove sulfates from the negative plates
- Install catalysts

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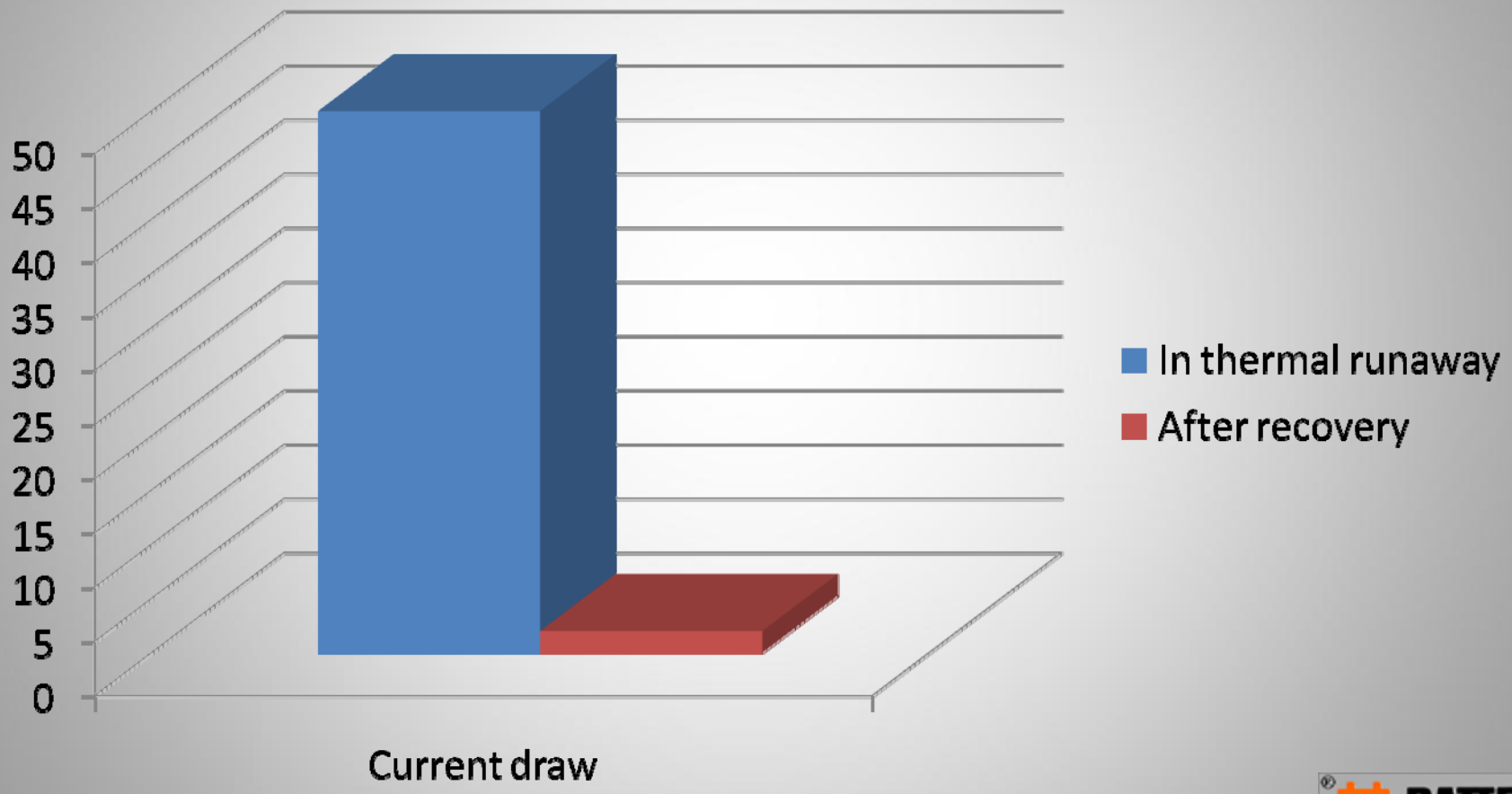
Before and after



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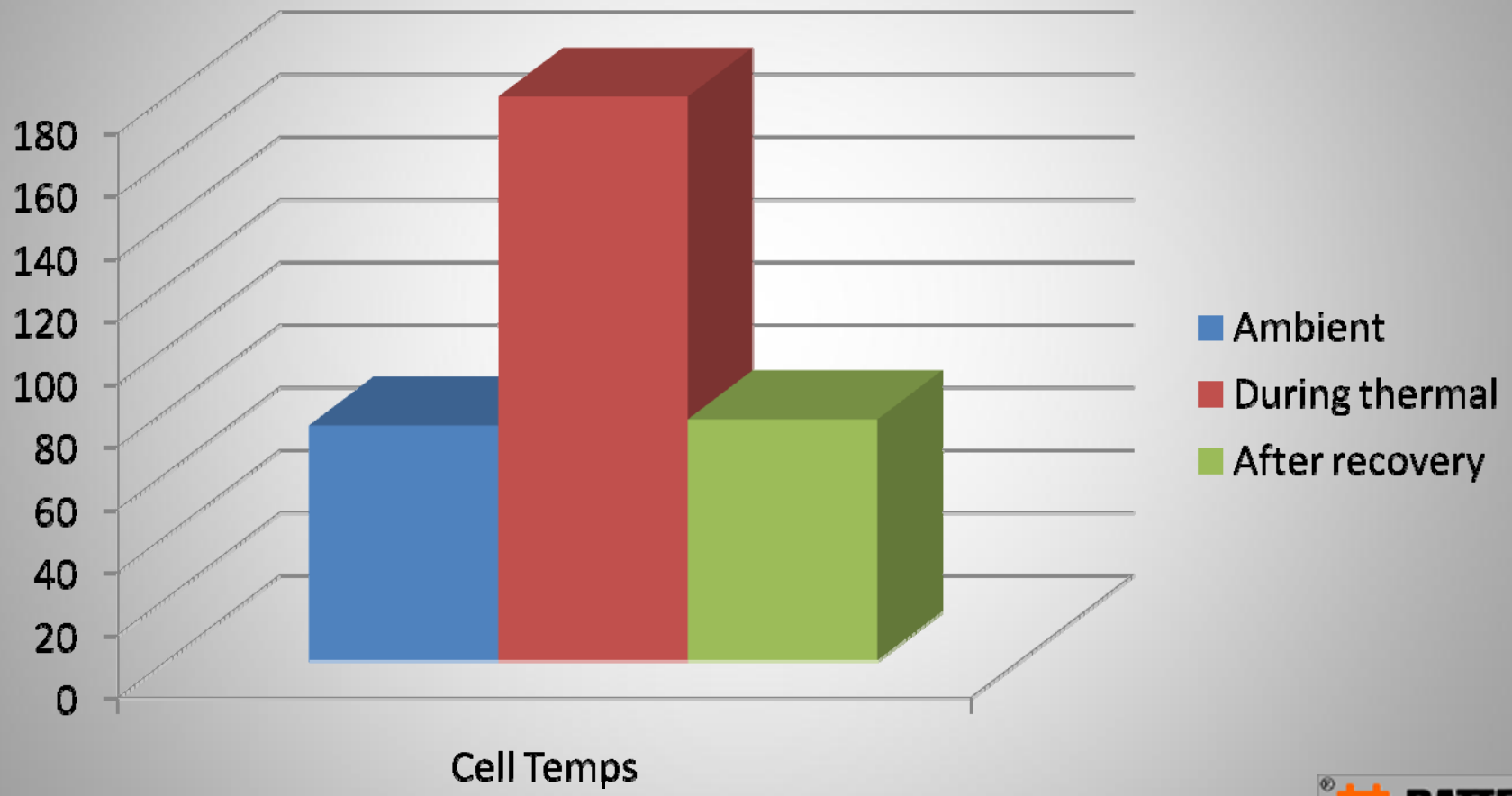
Before and after



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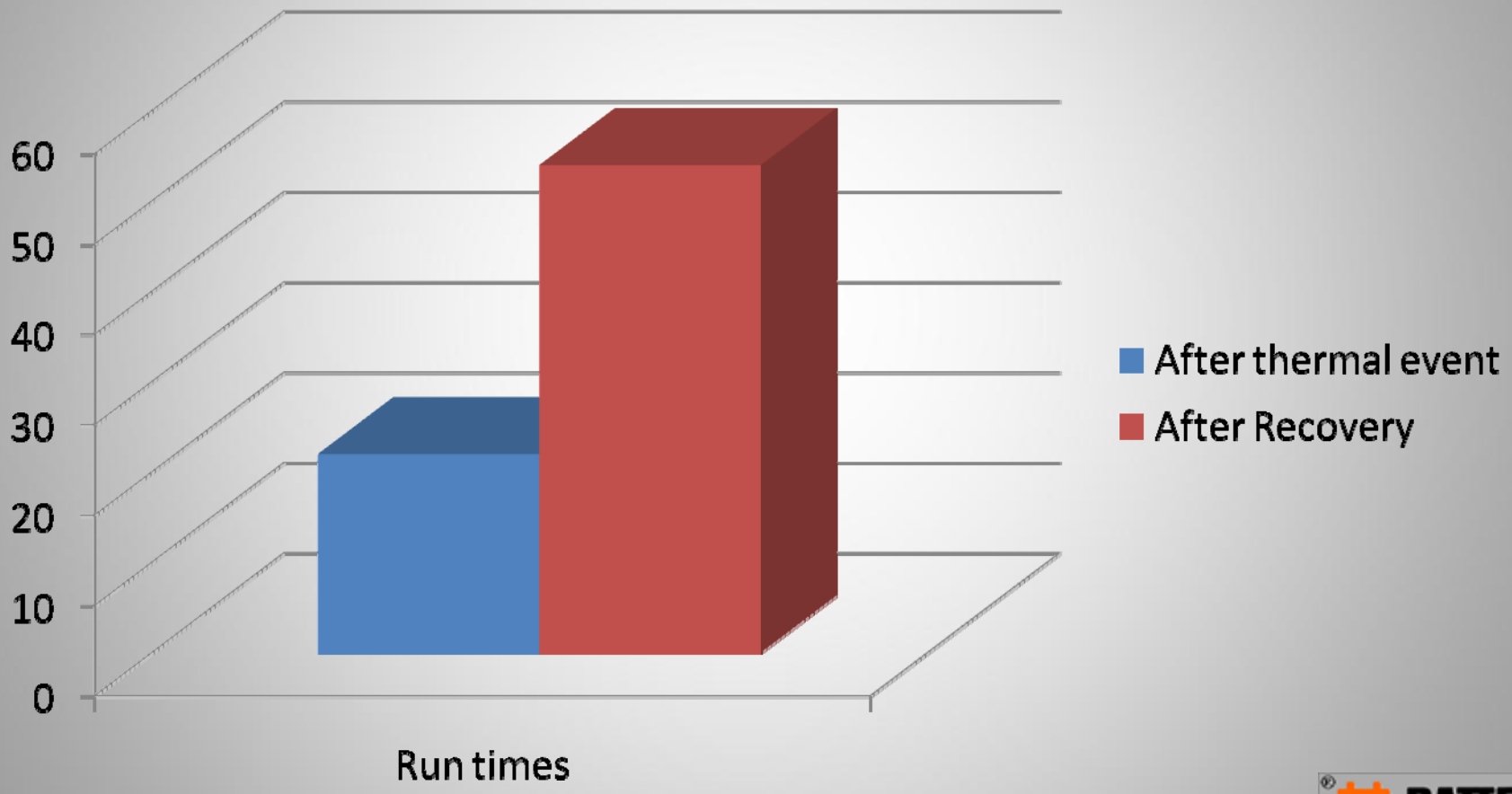
Run Times



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How to take the measurements

- Hand held meters
- Monitoring
- Accuracy, accuracy, accuracy
- Keep records, keep track of records
- TRACK READINGS

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What do you need to know?

- Over-all float voltage.
- Differential between ambient temperature and cell temperature.
- Float current (current going thru the battery).
- Accuracy.

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Conclusion

- Now that the warning signs of thermal runaway are so easily observed, just who is responsible when it occurs?
- Now that it is understood that there are means of recovering from thermal runaway it allows a user to be more pro-active instead of re-active.
- It is my hope that this paper will help anyone who reads it to understand that they are now in control of their batteries, and there are no surprises.

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